FARMERS BULLETIN 1103
United States Department of Agriculture

Growing Irrigated Grain in Southern Idaho

THE PRODUCTION OF CEREALS under irrigation in southern Idaho was greatly stimulated by war-time needs. Small grain on irrigated land was not previously regarded as profitable in comparison with other crops except as the first crop on new land.

The growing of cereals is essential to the development of the live-stock industry and also to the safe diversification and proper rotation of crops. This is especially true in southern Idaho, at a long distance from market.

When given the same care that is bestowed on sugar beets and alfalfa, the small grains give good returns. They are especially adapted where irrigation water is limited.

The preparation of the land for irrigation and seeding is very important. Care in leveling is well repaid in time saved in irrigating and in better yields and more uniform quality.

Clean seed of the best adapted varieties, treated to prevent smut and properly drilled on a well-prepared seed bed, go far toward insuring a good yield.

Dicklow and Pacific Bluestem wheats; Golden Rain, Early Mountain, Silvermine, and Kherson oats; and Trebi, Beldi, and Hannchen barleys are the leading varieties.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. May, 1920.

GROWING IRRIGATED GRAIN IN SOUTHERN IDAHO.

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[In cooperation with the Idaho Agricultural Experiment Station.]

CONTENTS.

CEREALS IMPORTANT IN IDAHO.

CEREALS constitute some of the most important cash and feed crops grown on the irrigated lands of southern Idaho. Until the outbreak of the World War the increase in the production of wheat, oats, and barley had been gradual and had kept pace with the areas of new land placed under irrigation. The acreage of wheat during the war was greatly increased at the expense of oats, alfalfa, clover, and other crops. A slight increase in the acreage of barley resulted from the demand for this grain as a substitute for wheat in bread making. The small grains have been used almost exclusively as the first crop in bringing the virgin soils under cultivation. This is due to the ease with which the grains can be grown, the small seed cost, the practically assured returns, and the ready market, particularly for wheat. Interest in the production of barley is spreading quite rapidly, as the feeding value of the grain becomes more generally known.

The increased production of cereals, especially barley, has had a stimulating effect upon the live-stock industry, which has prospered in southern Idaho. Feed has been plentiful, and the moderate winters encourage the wintering of stock which would otherwise be shipped out of the country. The long distance from market makes it imperative that the live-stock industry be fostered to the fullest extent. Grain production in itself is not a profitable type of agricul-

ture for irrigated lands. The home feeding of bulky crops which are expensive to ship not only brings in higher net returns by saving shipping costs, but also assists greatly in maintaining the fertility of the soil and the permanency of the agriculture. The diversification of crops overcomes losses occasioned by market fluctuations, which would otherwise be disastrous under a system of single cropping. This diversified agriculture and increase in live stock has been fostered considerably by a rational policy for the control of forest range and leased range, which permits the owners of small farms to obtain range for a few head of stock.

THE SNAKE RIVER BASIN.

This bulletin is intended primarily for settlers on the irrigated lands of the Snake River basin in southern Idaho. This territory includes irrigated lands in every county in the southern and southeastern parts of the State. Figure 1 shows a map of Idaho and the approximate location of the irrigated areas in each of the southern counties. The estimated irrigated area of southern Idaho is 1,723,278 acres and is constantly being increased as new lands are made ready for irrigation. Some of these districts have more water for crop production than others, depending to a considerable extent upon the priority of water rights. A few sections have priority rights, but the original supply of water has never been adequate. The drought of 1919 stimulated great interest in additional storage capacity to insure a reserve for dry seasons.

CLIMATE.

The general climate of the Snake River basin is arid or semiarid. The altitude varies from about 6,000 feet in the Teton basin, near the headwaters of the Snake River, to about 2,100 feet in the lower part of the basin near the Oregon line. The great variations in altitude cause corresponding variations in the temperature and in the length of the growing season. In the upper part of the valley the temperature seldom exceeds 90° F. in summer or falls lower than 15° to 20° below zero in winter. At the lower altitudes near the Oregon line summer temperatures of 100° F. or higher are often reported, while the winter minimum seldom reaches zero. Throughout this basin the daily range of temperature is very great.

The average annual precipitation at the substation at Aberdeen, Idaho, for the six years from 1913 to 1918 was 9.59 inches. The average for the various irrigated sections of the State varies from 8 to 12 inches per annum. The precipitation is greater in the mountain valleys than on the plains. The distribution of the summer rainfall is very irregular, as will be noted in figure 2.

Warm chinook winds often cause rapid melting of the light snowfall on the plains, resulting in the escape of the moisture as runoff, if the ground is frozen. In the mountain valleys snow falls relatively early in the autumn and usually remains until spring weather arrives. As a rule, the ground is seldom frozen in these higher valleys where early deep snows prevail. Westerly winds prevail over southern Idaho. In summer and fall the winds frequently are strong in the afternoon. The average daily wind velocity in the months of April, May, June, July, August, and September, as recorded at the Aberdeen substation during the six years from 1913 to 1918, inclusive, was 5.82 miles an hour. The average daily evaporation from a free water surface during the same period was 0.209 inch.

The average date of the last killing frost in the spring is June 8, and of the first killing frost in the fall September 16. The average length of the

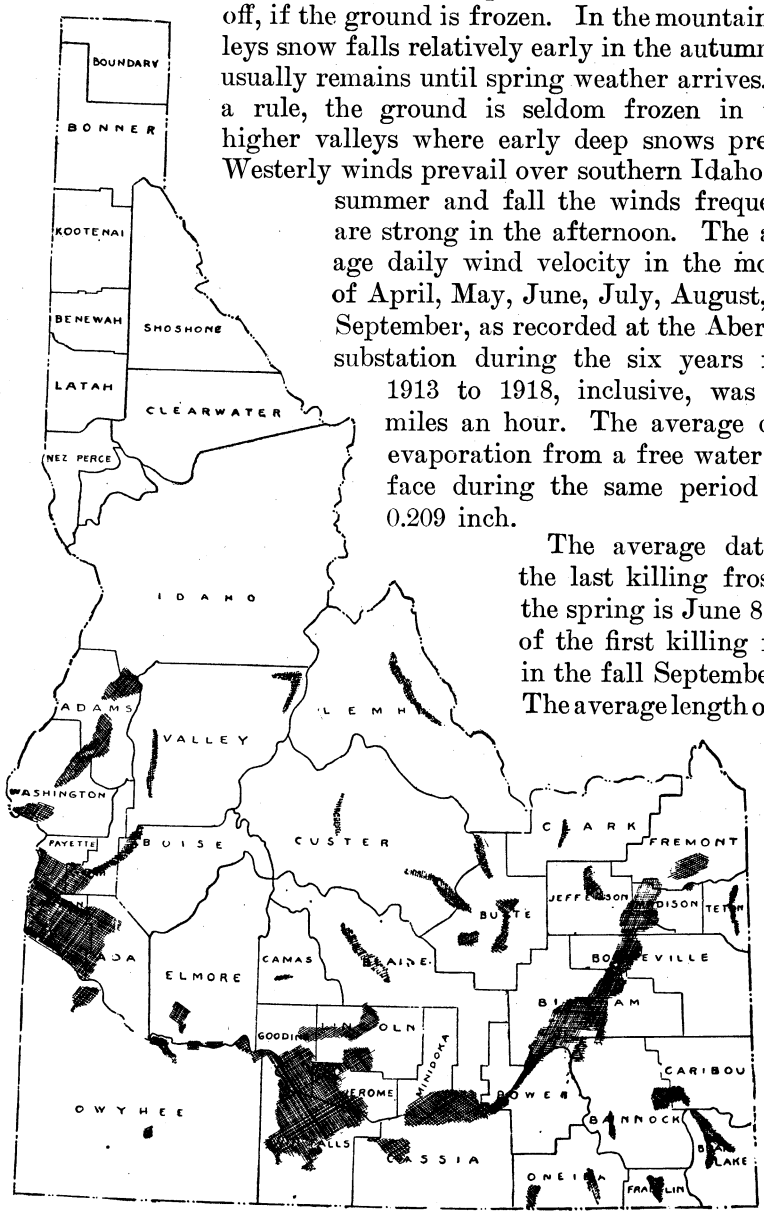

FIG. 1.—Outline map of Idaho, showing approximately the area of irrigated land in each of the southern counties.

growing season, that is, the frost-free period, at Aberdeen is 101 days. In the upper Snake River valley the frost-free period is shorter, and in the lower part of the valley near the Oregon line it is much longer.

SOILS.

The soils of southern Idaho are of volcanic origin. Most of the soil covering the plains at a distance from the mountains and the outside canyons is fine material redeposited by the wind. It is a yel-

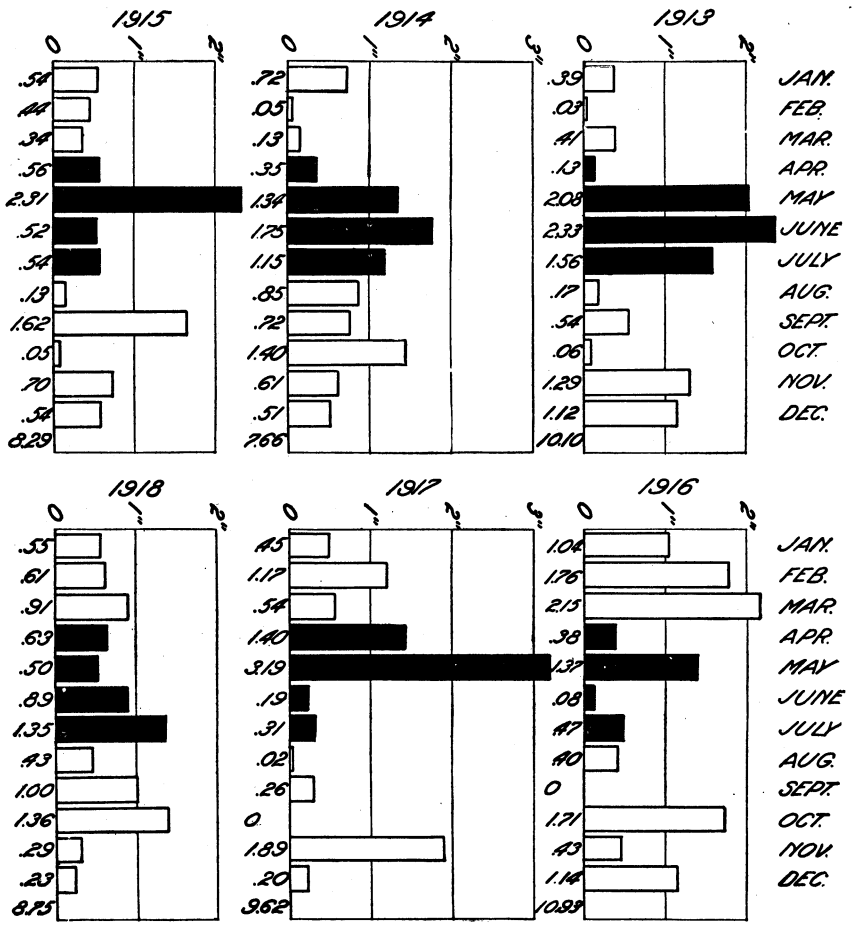

FIG. 2.—Graph showing monthly, seasonal, and annual precipitation, in inches, at the Aberdeen substation, Aberdeen, Idaho, during the six years from 1913 to 1918, inclusive. The precipitation during the growing season (April to July, inclusive) is indicated by shading.

lowish white silt, composed mainly of fine quartz particles. The most common soil type is a sandy clay loam. A considerable portion of the soil in the irrigated portions of the mountain valleys is composed of mountain wash or alluvial soil. This soil is also a sandy clay-loam type, but it contains more decayed vegetable matter. The upper Snake River valley soils contain more sand and gravel than

those of the lower valley, and the color is generally darker, often a reddish brown at the high altitudes. The soils in some parts of the upper Snake River valley, probably the old river bed or former flood plain, contain much gravel and as a rule require much more water to produce a profitable crop than the normal soils.

The mineral plant foods are abundant in the soils of southern Idaho. Humus and nitrogen are the two substances lacking, but under irrigation these can be supplied by the growing and plowing under of leguminous crops, such as alfalfa and clover, as well as by the use of manures. The great abundance of lime in the soil enables these crops to grow vigorously. In a few sections of the State natural drainage is not sufficient. In these places, water-logging has occurred, with the consequent rise of alkali and loss of cropped land. Artificial drainage in these sections is being undertaken with much success. This condition should be anticipated by the farmers in sections where the land is relatively flat and water-logging is likely to develop. Much loss of land, labor, and money could be avoided by providing drainage soon after the irrigation system has been established.

LEVELING FOR IRRIGATION.

The best returns from cereals grown under irrigation can be obtained only when the land has been well leveled. Properly leveled lands permit easy, thorough, and complete irrigation. Poorly leveled lands are expensive to irrigate, require more water and more labor than land well leveled, and return a less yield per acre. Spots too high to receive water should be cut down and used to fill up "pot-holes," where water naturally collects. Some objection to removing the high spots is made, because the subsoil is thereby exposed and unproductive spots result. However, a spot too high for watering is just as unproductive, and remains permanently so, whereas the southern Idaho subsoil, if exposed through leveling, can soon be made productive by the use of manures and alfalfa. Before the leveling operation is begun, the general contour of the land should be well noted. Natural drainage should be left open so far as possible. The leveling should conform so far as possible to the natural contour of the land.

Before the leveling is begun, it should be decided whether the check method, the border method, the corrugation method, or the regular contour flooding method is to be used. Land sloping in more than one direction is best irrigated by the corrugation method, unless the slope is only slight, in which case the border method can be used. The normal flooding method can be used if the field laterals are comparatively close together, at most not over 300 feet apart. So

far as possible, water should be allowed to take the direction of its natural flow. Very sloping land is best irrigated by the corrugation method, and the corrugations should be coursed around the hill rather than straight down the slope. Washing will result otherwise. Such land, to overcome washing, should be used for hay or pasture.

The best time to do leveling is in the fall, before the land is plowed, as the leveled and plowed land can settle during the winter and be in ideal condition for seeding in the spring. It is not advisable to plow the entire field before leveling is begun. More horse power is required to pull the scraper over plowed land than over firm land. Furthermore, it is much more difficult to be sure when the land is level, because fresh plowing is easily tramped down in scraping and looks lower than adjacent untramped plowing. Plow or double disk only the high spots and haul the dirt from these to adjacent unplowed lower ground. Irrigators become very proficient in locating high and low spots and often do not require the aid of an instrument in leveling land. The use of an instrument, however, makes leveling certain and often prevents loss.

After the land has been fairly well leveled, the field should be double disked and floated and a trial irrigation given. As soon as the land is dry enough to work, the few spots needing additional leveling should be given attention and the field can then be plowed. The irrigation which the field has received will make it easy to plow, and the land will firm and work down well.

LEVELING AND TILLING MACHINERY.

There are many implements from which to select for use on irrigated lands. The equipment for an irrigated farm of average size should include a 14-inch or 16-inch two-way sulky plow for general field plowing. It is desirable to have a 14-inch walking plow for ditch making, cleaning, and plowing corners too small for the two-way sulky. A disk harrow and a common spike-tooth harrow should be provided, in addition to a spring-tooth harrow, a tool especially adapted for alfalfa cultivation. A wooden float at least 14 feet long and from 6 to 10 feet wide, depending upon the horse power available, is an absolute necessity. A scraper (fig. 3) is an essential implement wherever much leveling must be done. For firming soil, a corrugated roller is an essential implement on any well-diversified irrigated farm and is of particular value in sugar-beet growing. Various forms of crowders are in use for opening ditches. A good homemade V-type crowder in use at the Aberdeen substation is shown in figure 4, while an excellent ditcher, which can be bought ready made, is shown in figure 5.

SEED-BED PREPARATION.

A seed bed for cereals must above all else be firm and yet well fined. This means not pulverized so fine that it will blow, but that it is free from lumps. A firm seed bed, such as is provided by fall plowing and early spring preparation, will be found to give excellent stands of small grains. Spring-plowed land can be worked down sufficiently to make a good seed bed, but requires more work than when the land has been fall plowed. The long winter settling of fall-plowed land provides a firm seed bed which can be obtained in no other way. Corrugated rollers, packers, and disk harrows with disks set straight are all used in firming spring-plowed land. The corrugated roller probably is the best implement to purchase, as it can be used for other purposes as well. For completing the leveling of the land, a float (fig. 6) is useful.

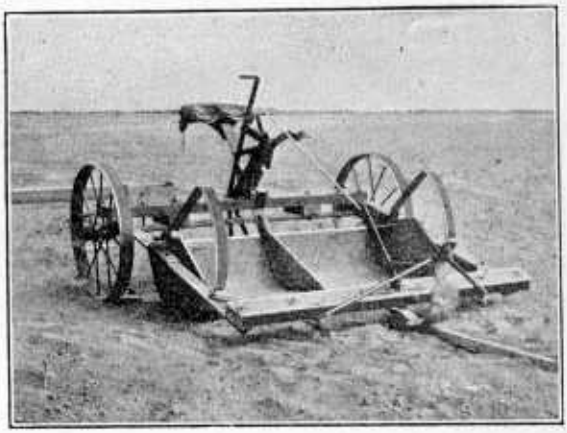

FIG. 3.—One of the best types of automatic scrapers and land levelers for use in preparing land for irrigation.

Sugar-beet land or potato land, if free from weeds and trash, need not be plowed in preparation for a seed bed for cereals. A good job usually can be done with the disk harrow or spring-tooth harrow on such land and much time and labor saved. Land on which alfalfa was plowed under will produce an excellent crop of small grain if care is taken in plowing and preparation. The best seed bed on alfalfa land can be prepared by the method of double plowing. This consists in cutting the crowns of the alfalfa by plowing as shallow as possible and later plowing this crowned land 6 to 8 inches deep, turning under the crowns. In addition to turning under the crowns to kill them and to prevent trouble in leveling, much additional plant food is provided for the immediate use of the crop. Clover requires but one plowing, and if done in the fall an excellent seed bed can be prepared. Leveling land for irrigation is very important and must be kept in mind in seed-bed preparation.

The two-way plow is by far the best tillage implement for an irrigated farm. This plow, if handled properly, saves much of the

work of leveling for irrigation, as no dead furrows are made by it. Hillsides and ditches may be leveled to a great extent by the use of the two-way plow, as the furrows may all be turned one way.

CEREALS IN THE ROTATION.

On well-leveled highly productive irrigated land the cereal crop is regarded as the least profitable crop grown in the rotation. The usual rotation of crops in the better farmed sections of southern Idaho includes alfalfa three or more years, then beets or potatoes two to three years, and then cereals two or three years, with the last crop used as a nurse crop for alfalfa. A variation of this rotation has clover instead of alfalfa for two years, beets or potatoes two years, and cereals one year, the land then being seeded back to clover. This rotation is particularly well adapted to clover-seed production, as it eliminates weeds and removes a great amount of plant food, so that the clover crop will not make too much growth. A heavy vegetative growth of clover is not favorable to seed production.

FIG. 4.—A homemade crowder.

A cereal rotation adapted to live-stock production would include alfalfa three or four years, root crops one year, and cereals two or three years, with alfalfa sown in the last cereal crop. This rotation will suit any live-stock farm where hay, grain, roots, and silage are used in feeding. Corn for silage can be substituted for some of the small grain in the rotation.

WINTER GRAIN NOT ADAPTED.

Winter grains are not adapted for use in any rotation system on irrigated land. Winter wheat is not economically profitable from a labor standpoint and, in addition, does not yield as well as spring wheat. If the winter wheat used is a hard red variety, it usually will contain a high percentage of yellow berry when grown under irrigation and is subject to a low grade under the new wheat-grading standards. It is better to fall plow the land and prepare a good

seed bed for early spring seeding than to sow winter wheat and run the chances of loss by winterkilling, reduced yield, and low grade.

Winter oats and winter barley do not survive the winter and hence are not of commercial value in southern Idaho.

WHEAT, OATS, AND BARLEY AS NURSE CROPS.

Wheat, oats, and barley are used as nurse crops for alfalfa and clover. Practically all fields seeded down to alfalfa and clover in southern Idaho are sown with a nurse crop. Good stands usually are obtained, and the nurse crop, which nearly always is cut for grain, is remunerative. Early varieties should be used whenever available, so that the crop may be removed as early as possible and water applied to the young clover or alfalfa plants.

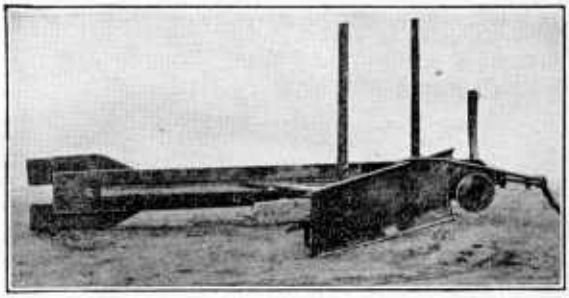

FIG. 5.—One of the best types of ditcher.

Barley is preferable to wheat or oats as a nurse crop, as it matures earlier and does not shade the ground as much as oats or wheat. Varieties of 6-rowed barley are better than most 2-rowed varieties, because they ripen a week to ten days earlier and the better 6-rowed varieties outyield the 2-rowed types.

It is advisable to reduce the rate of seeding of the nurse crop to about three-fourths of the normal rate when sown alone. The nurse crop may be sown early and allowed to grow to a height of 4 or 5 inches before the clover or alfalfa is seeded. In that event the legumes should be sown broadcast, preferably with a grain drill, in order that even distribution may be obtained. Clover or alfalfa should not be sown with the grain, that is, running into the same drill row and at the same depth as the grain. If time is not available to sow the alfalfa or clover after the grain has been seeded, it is advisable to take the lower ends of the spiral spouts out of the openings of the drill hose and straighten them out, so that the seed is sown broadcast ahead of the drill. Most of the seed is covered in this way, but the disadvantage is that the clover or alfalfa seeds are not all covered to the same depth. An uneven germination and only fair stands often result.

WHEAT, OATS, AND BARLEY IN MIXTURES.

Oats are used more than wheat or barley on irrigated lands for growing in mixtures for hay or silage. Oats and peas make an excel-

lent hay combination where alfalfa or clover hay is not available. The Animal Husbandry Department of the University of Idaho has grown peas combined with oats and with wheat for silage, and these mixtures have been very satisfactory when fed to live stock in comparison with corn silage. The combinations are particularly valuable in the upper Snake River basin, where corn is more or less likely to be injured by frosts and where the tonnage of corn silage is not great, owing to the slow growth made at high altitudes. The Silvermine is an excellent variety for use as a hay and forage oat in such mixtures. A mixture of 50 pounds of oats and 100 pounds of peas per acre makes a good combination if sown early. Figure 7 shows a fine crop of peas and oats during harvest.

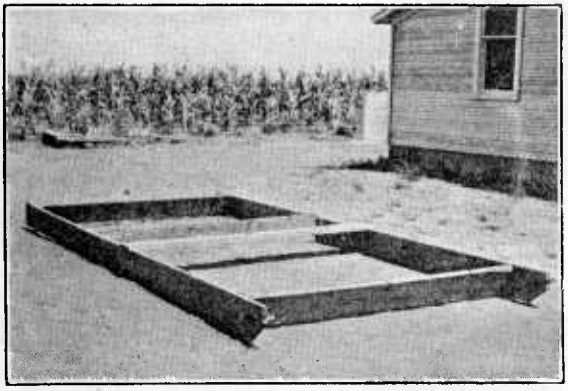

FIG. 6.—A float used for leveling and completing the preparation of a good seed bed on irrigated land.

SEED AND SEEDING.

CLEANING THE SEED.

Seed should be cleaned well before sowing. Chaff and straw clog up the drill and a good stand can not be obtained. Sowing shrunken and cracked grain causes losses in stand, as only a small part of such seed grows and at best will produce only weak plants. Such seed is valuable for feed and should not be wasted by sowing it.

Plump seed also is less injured by the treatment to prevent smut and always germinates better than shrunken or light seed. The varieties recommended in this bulletin may be obtained from the Aberdeen substation or other reliable local sources.

TREATMENT TO PREVENT SMUT.

If the grain has been previously fanned and all smut balls removed, the seed is ready for treatment. The formaldehyde treatment for stinking smut requires soaking the grain from 5 to 10 minutes in a solution of 1 pint of commercial formaldehyde to 45 gallons of water.

If reasonable care is exercised in the formaldehyde treatment, the loss due to injury can be reduced to a very small percentage. Injury

from the use of formaldehyde usually is due to overtreatment. It is not necessary to soak the grain more than 10 minutes in the formaldehyde solution. Five minutes often will suffice. After the seed has been soaked for 5 to 10 minutes, the solution should be drained off and the grain piled up and covered for about two hours to thoroughly distribute the formaldehyde gas throughout the pile. The seed should then be spread out thinly and dried sufficiently to run through a drill. The best results will be obtained if the grain is sown just as soon as it is sufficiently dry. For further information on the smuts of cereals and their treatment, see Farmers' Bulletin 939, entitled "Cereal Smuts and the Disinfection of Seed Grain."

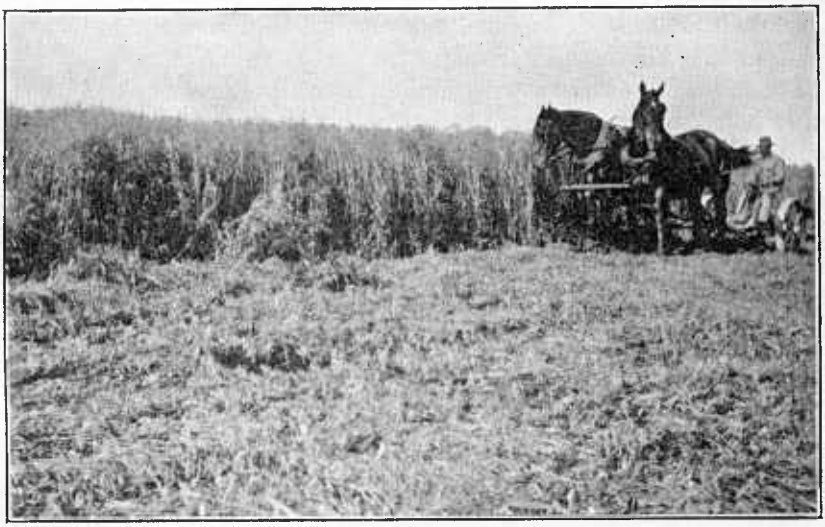

FIG. 7.—An excellent crop of oats and peas at the Aberdeen substation.

EARLY SOWING OF CEREALS.

Wheat, barley, and oats should be sown early to secure the best results. At Aberdeen, sowing ordinarily can be begun about the middle of April. In the upper Snake River basin, seeding can be done in May. At the high altitudes, the farmers, realizing that the season is short, lose no time in getting their grains into the ground. At the lower altitudes, where the season is relatively long, seeding usually is postponed, not from necessity but simply because the crop will mature although seeded late. Growers who thus postpone seeding probably do not realize that early sowing will give greater returns. Small grains require some cool weather during the period of early growth, in order to tiller properly. Late-sown crops do not tiller nearly as well as early-sown crops.

GRAIN DRILLS.

There is no longer any question among Idaho farmers as to the advantage of drilling seed over broadcasting. There is still some controversy as to whether a 6-inch drill is better than one with drills spaced 7 inches apart and also whether a 3½-inch drill is better than either of these. Doubt also exists as to the relative merits of disk, shoe, and hoe drills.

Both 6-inch and 7-inch drills are used extensively on irrigated lands and are satisfactory. The 6-inch drill is coming more and more into favor for well-tilled land. Drill rows spaced closer than this, however, have little to recommend them for irrigated lands. If the grain is sown early, the plants tiller freely, and the space between these drill rows is quickly filled up. Cross drilling is favored by some farmers to obtain a thick stand.

The main reason for sowing closely is to eliminate weeds. On the other hand, where grains are to be used as nurse crops, the very close drill rows are particularly objectionable, because very thick seeding chokes out the leguminous crop. No information is available to show that yields from grain sown in closely spaced drill rows are better than those obtained from 6-inch or 7-inch drill rows.

Single-disk drills are especially useful on land which is somewhat trashy. These drills also will do very good work on clean land. The double-disk drill, the hoe drill, and the shoe drill are most useful on clean land.

QUANTITY OF SEED TO SOW.

The rates of seeding cereals on the irrigated lands have been gradually increased. This is due in part to soil improvement and the consequent ability of the richer soil to support a heavier stand. In the early days of irrigation farming in southern Idaho 6 pecks of wheat was considered an ample seeding, but 2 bushels per acre is now becoming a very popular rate of seeding for wheat on well-improved land. Oats should be sown at 2½ to 3 bushels per acre, and barley from 2 to 2½ bushels per acre. If the grain is swollen from seed treatment, the drill openings should be slightly increased to insure sowing at the proper rate. When cereals are used as nurse crops the rate of seeding should not exceed three-fourths of the normal quantity.

METHODS OF IRRIGATION.[1]

As a rule, less care is taken in preparing irrigated lands for grain crops than for any other crop. This is due in part to the fact that grain will produce some sort of return under very adverse conditions;

[1] For more complete information on this subject the reader should consult Farmers' Bulletins 863, entitled "Irrigation of Grain," and 864, entitled "Practical Information for Beginners in Irrigation." These bulletins may be obtained free on application to the United States Department of Agriculture.

therefore, much is left to chance. Another reason for less attention being given to land producing these crops is that grain has been considered one of the least profitable crops grown on irrigated land. High prices during the war period, however, stimulated production, and many farmers have learned that large yields of grain can be obtained if attention is given to land preparation and proper irrigation.

Irrigation water may be applied in several different ways. Flooding is the most common method in use. Irrigation by the border method and also by the corrugation method is becoming quite general in southern Idaho. Each system has its limitations, but both are good, and a combination of the two gives excellent results. The check method is less commonly employed.

THE FLOODING METHOD.

Flooding is the original method of irrigation and may be done in any one of several ways. The most common way is by flooding from field laterals. This method consists of running small ditches across the field in such a way as to permit the water to be carried to all parts, and letting it out of these ditches without other direction than is given it by the irrigator with his shovel.

THE BORDER METHOD.

A border is a low rounding levee just high enough to prevent the water from overtopping it in its course down the slope and yet permit seeding and harvesting machinery to pass over it without injury. The borders, or levees, are made by back furrowing with a plow or by scraping together soil not required for filling depressions.

The border method is only a modification of the flooding method. It consists of making a series of parallel levees or borders at intervals of 50 to 100 feet down the slope from the supply ditch. The purpose of these levees is to guide the water down the slope. The border method is coming into more general use in Idaho as its advantages become apparent. It is particularly well adapted to level land or land with little slope. The more sloping the land the closer together should be the borders. The land between borders should be leveled so that the water will cover all the surface evenly as it progresses down the field.

Preparing land for border irrigation requires more labor than preparation for normal flooding. The labor cost is quickly made up, however, in the time and money saved in irrigating and the increased yields which result. If the leveling has been well done, the borders will require but little attention other than turning in the water.

The length of the borders will depend considerably upon the character of the soil. Sandy or gravelly land will permit only short

flows before the water disappears in the subsoil. Long flows can be made on the heavier soils, but at most a 600-foot flow is long enough. A waste ditch should be provided at the lower end of the border and another set of borders begun. A field ditch at right angles to the supply ditch is required to supply water to these lower borders. Borders of the same length are desirable and should be made wherever the contour of the land permits. A farm with border units of uniform lengths can be handled much more easily in a system of crop rotation than one with units of different lengths.

An irrigation system well constructed for use of the border method will permit large heads of water to be used except on very heavy soils, and to this end good-sized ditches should be provided. Large heads forced over quickly and at comparatively short intervals of time reduce labor costs, insure thorough irrigation, and are better for the crops being irrigated than heavy irrigations at long intervals.

THE CORRUGATION METHOD.

Corrugations are small furrows opened by means of a shovel attachment on a beet cultivator or by an implement called a corrugator. The corrugations vary in spacing from 12 to 24 or more inches, depending upon the nature of the soil. The corrugation method is particularly well adapted to uneven or sloping land. On decidedly sloping land the corrugations are coursed around the hills rather than straight down, in order to avoid washing. Corrugating must be done immediately after seeding and before the grain has started to sprout. On most Idaho soils corrugations spaced 14 to 16 inches apart give the best results. A field irrigated by the corrugation method is shown in figure 8.

THE CHECK METHOD.

In the check method, the field is divided into basins or checks by means of low levees. Water is admitted to the checks in turn and allowed to flow until the entire surface is submerged. The slope of the land within a check must be less than the height of the levees, in order that all parts may be submerged without causing the water to overflow. On the other hand, the levees must be low enough to permit farm machinery to pass over them. For these reasons the check method is adapted only to land having a gentle slope, as on land having a steep slope the levees would have to be too close together to be practicable.

The borders of the checks are made in the same way as the borders for the border method. The check method is an ideal method of applying water. If properly operated it absolutely prevents surface waste. Care must be taken, however, to shut the water out of a check as soon as the soil is properly moistened, since too much standing water on plants will cause serious injury to the crop.

WHEN TO IRRIGATE GRAIN.

Grain should be irrigated when the crop needs water, regardless of the stage of growth of the grain. Set rules for the irrigation of any crop are misleading, and any attempt to follow them rigidly often results disastrously. Seasons vary, and the time to irrigate a crop varies considerably with the season. Summer rains often are misleading, unless they exceed a half inch. Every year they are indirectly responsible for considerable loss in the irrigated sections. In southern Idaho, where the average precipitation during the growing season is 4.27 inches, it is a mistake to take the average shower too seriously. The immediate surface moisture is of little value in crop

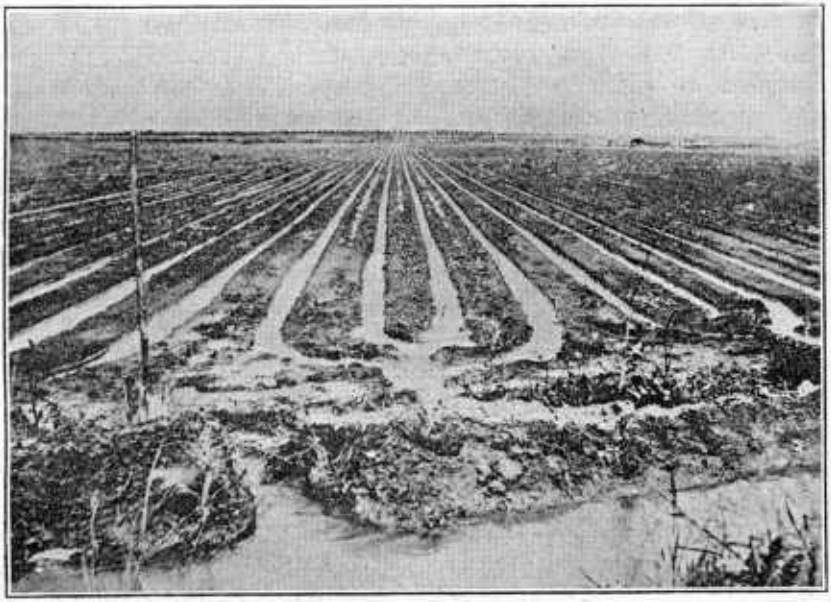

FIG. 8.—Land irrigated by the corrugation method.

production, and unless the ground is moist to a considerable depth the crop should be irrigated, regardless of the little moisture from small rains.

The time to apply water to grain can be determined very well by the color of the foliage. Grain crops not having sufficient water become dark green, and the leaves droop considerably during the warmer parts of the day. Plants having sufficient water have a bright-green color and the leaves seldom droop unless the weather is intensely hot. An experienced irrigator can tell, by handling the soil immediately below the surface, when water must be applied. By associating the color of the foliage, the drooping position of the leaves, and the "feel" of the soil, an experienced irrigator can

always tell when to apply water and about how much to apply. Grain should not be permitted to burn, as the growth is checked thereby and yields reduced. On the other hand, too much irrigation will produce too much straw, at the expense of the seed yield. Irrigation should be held off as long as possible during the early stages of growth, in order to prevent too vigorous a growth of straw, particularly if the grain is on alfalfa land or other highly enriched soil.

Three or four irrigations in the average season should be sufficient. The crop will do better if the moisture content of the soil is kept fairly constant, and for this reason several light irrigations at frequent intervals will give better results than a smaller number of heavy irrigations at long intervals.

Grain should not be watered, if possible, until after sufficient growth has been made to shade the ground. Occasionally, the precipitation in winter and early spring is not sufficient to cause the grain to make such a growth. In that event, the field should be irrigated by means of corrugations, but not flooded. Flooding land before the crop shades the soil will cause the baking of all except very sandy or gravelly soils. A hard crust will be formed which prevents air from reaching the roots and retards growth, often killing many plants. Rarely, it may be necessary to irrigate before seeding, if the spring is unusually dry.

RESULTS AT THE ABERDEEN SUBSTATION.[1]

Work at the Aberdeen substation was begun in 1912. The land was cleared of brush, plowed, and made ready for seeding. Ditches on the irrigated portion were laid out and constructed and the land leveled. Varietal experiments with cereals were begun in 1913. Individual plats were used for three years, with checks at intervals of five plats. In 1916, duplicate fortieth-acre plats of all varieties were established and have been continued to date. In the fall of 1918, operations were begun to irrigate the entire substation, part of which had previously been dry farmed.

In addition to handling many varieties in the field plats, a nursery of many hundreds of varieties and strains of small grains has been conducted, looking toward the improvement of these crops in southern Idaho.

Cereals always have followed potatoes in the rotation at the Aberdeen substation. The rotation consists of alfalfa four years, then potatoes, cereals, and peas, after which peas or cereals are used as a nurse crop for alfalfa. After the first cereal crop is removed, 15 to 20 tons of manure per acre are spread on the land. This is plowed

[1] The experiments at the Aberdeen substation are conducted in cooperation with the Idaho Agricultural Experiment Station, and joint credit is due that station for the results presented here.

under in the fall and peas sown in the early spring. If it is desired to get the land back to alfalfa earlier than the above rotation permits, alfalfa may be sown with the first pea crop, thus gaining one year. Grain seems to do better following potatoes or sugar beets, and the field is free from weeds if the potato and beet crops have been given the attention necessary for high yields.

Seed of the varieties recommended in this bulletin usually can be purchased at the Aberdeen substation.

WHEAT.

Table I shows the results of experiments with the leading spring wheats on irrigated land. The experiments included 16 varieties during the six years from 1913 to 1918, but only eight varieties were

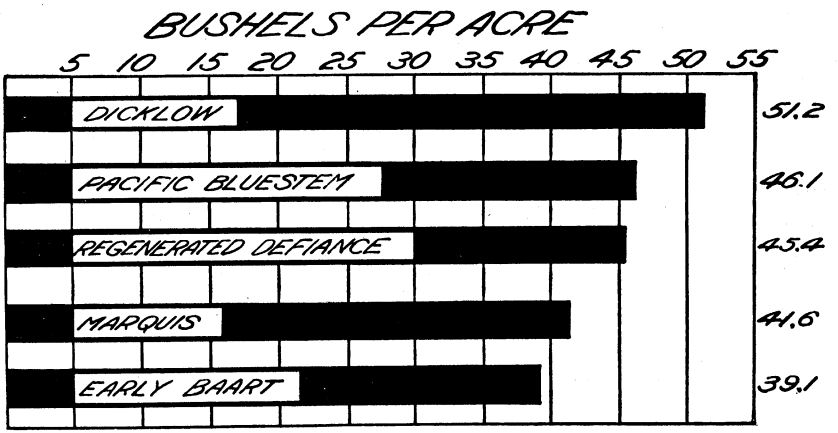

FIG. 9.—Diagram showing the average yields, in bushels per acre, of the highest yielding varieties of spring wheat grown on irrigated land at the Aberdeen substation in the six years from 1913 to 1918, inclusive.

grown during as many as four seasons. Of these eight, only four were grown during the entire six years.

Figure 9 shows graphically the average acre yields, in bushels, of the five leading varieties of spring wheat grown on irrigated land at the Aberdeen substation in the 6-year period from 1913 to 1918, inclusive.

The Dicklow has outyielded the other three varieties grown in all six years by an average yield of 5.1 bushels per acre each year, or a total of 30.6 bushels in six years. The Dicklow is a soft white wheat. The head is of medium length, broad and compact, often club shaped, beardless, with smooth, white chaff. The origin of the wheat is not definitely known, but all information thus far obtained indicates that it is a selection from the old California Gem or California Club.

Mr. James Holly, of Utah County, Utah, obtained some California Club wheat from northern California and seeded it on his farm. Excellent results were obtained, and he called the attention of his neighbor, Mr. Richard Low, to his new wheat. Mr. Low obtained some and grew it. He noticed that the wheat contained different types and proceeded to select the type which he liked best. He grew this selection for several years, and the neighbors soon began clamoring for "Dick" Low's wheat. As the wheat became spread over that section of Utah, it lost its personal connection with "Dick" Low and became known simply as Dicklow wheat.

TABLE I.— *Yields of eight varieties of spring wheat grown on irrigated land at the Aberdeen substation during the 6-year period from 1913 to 1918, inclusive.*

Variety.	C. I. No. *a*	Yield per acre (bushels).							
		1913	1914	1915	1916	1917	1918	Average.	
								3 years, 1914 to 1916.	6 years, 1913 to 1918.
Dicklow	3662	61.5	38.0	56.7	52.0	62.3	36.9	48.9	51.2
Pacific Bluestem	4067	42.0	38.9	60.3	54.0	51.0	30.6	51.1	46.1
Regenerated Defiance	3703	56.6	41.2	47.9	48.0	50.3	20.0	45.7	45.5
Marquis	3276	33.3	38.9	56.7	52.0	41.3	27.6	49.2	41.6
Early Baart	1697	.....	38.8	31.5	54.0	43.0	28.3	41.4	*b* 39.1
Little Club	4066	41.3	41.2	49.9	50.0	.....	.....	47.0	.....
Glyndon Fife	2874	.....	42.3	49.0	41.3	36.0	.....	44.2	.....
Haynes Bluestem	2873	36.0	27.4	38.7	34.6	44.6	.....	33.6	.....

a Cereal Investigations number. *b* Average for only five years, 1914 to 1918, inclusive.

In 1912 or 1913, Mr. John Breckinridge, manager of the Western Milling & Elevator Company, shipped into Twin Falls, Idaho, a considerable quantity of Dicklow wheat, and it became fairly well distributed over Twin Falls County. Mr. Carl Irwin, a farmer of Kimberley, Idaho, has made special efforts to improve the variety by selection and has obtained a very uniform type. Figure 10 shows a field of pure Dicklow wheat which averaged 60 bushels to the acre.

The variety is particularly well adapted to the irrigated lands of southern Idaho. It is not a specially good milling wheat when compared with the Turkey wheat grown on the dry lands, but it ranks well with other white wheats grown under irrigation in southern Idaho. The flour from the Dicklow wheat is particularly adapted for use in pastry, biscuit, and cracker making. Owing in part to these special qualities, much of the Dicklow wheat flour made in southern Idaho is shipped to the Southern States. Some Dicklow also is used to blend with hard wheat in the manufacture of bread flour. Before the World War, southern Idaho farmers fed considerable wheat to hogs.

The Dicklow wheat has a good, stiff straw, is of medium height, and stands up well under irrigation. When ripe, it shatters more easily than the Pacific Bluestem, but if cut when in the late hard dough stage it will not shatter. The average length of the growing period (days from sowing to maturity) of the Dicklow wheat under irrigation at Aberdeen has been 118 days. The Bluestem requires 117 days, the Marquis 112, and the Early Baart 106 days. The Bluestem and Defiance are objectionable because of the long straw produced when grown on fertile irrigated land. As soon as the heads become heavy, both varieties are likely to lodge and are then difficult to harvest. Lodging also causes serious losses in yield. Inasmuch as these varieties do not yield as well as the Dicklow, there is little to recommend them for use in southern Idaho.

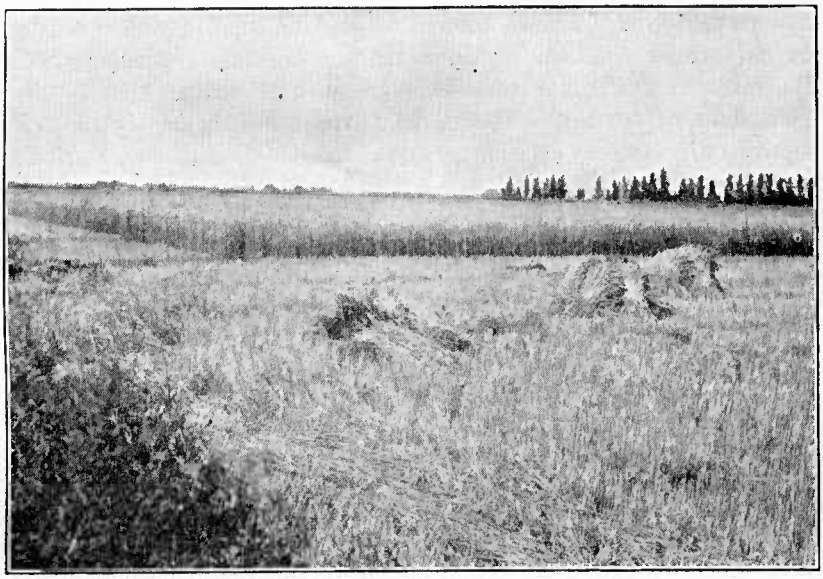

FIG. 10.—A field of pure Dicklow wheat which averaged 60 bushels to the acre.

The Marquis is a red spring wheat. In addition to being a lighter yielder than the Dicklow, the Marquis usually contains more or less yellow berry when grown under irrigation, and because of this it is docked on the market. Recent experiments, however, indicate that irrigation and climate are only partly responsible for yellow berry in red wheat. Investigation now points to the fact that irrigated land rich in nitrogen and amply supplied with other plant foods is capable of producing hard, red wheat high in protein content. The grain thus produced contains some yellow berry, but not nearly as much as red wheat produced on irrigated land which has not been fertilized or on land which has not grown a crop of alfalfa or clover.

OATS.

The experiments with oats have included 28 varieties during the 6-year period. Table II shows the yields of the 8 varieties which have been grown during five or six years. Many varieties were discarded as the tests progressed, while new varieties from the oat nursery were added as their merits warranted. Owing to insufficient area of land and the desire to replicate all varieties, many good varieties of oats were dropped in 1916. However, it is felt that the best varieties from all standpoints have been continued.

The Golden Rain, Early Mountain, and Silvermine have proved the best three varieties in the 6-year period. The same varieties also lead in the 5-year period, with Kherson a very close fourth. The Kherson has yielded remarkably well at Aberdeen, considering that it is an early oat. The Golden Rain is a midseason yellow oat, and the Silvermine and Early Mountain are midseason white varieties. The midseason varieties, on the average, have matured in 109 days from date of sowing. The early varieties, such as the Kherson, require only 102 days. The greatest seasonal variation was 25 days in the 6-year period.

TABLE II.—*Yields of oat varieties grown on irrigated land at the Aberdeen substation during the 6-year period from 1913 to 1918, inclusive.*

Variety.	C. I. No.[1]	Yields per acre (bushels).							
		1913	1914	1915	1916	1917	1918	Average.	
								5 years, 1913 to 1917.	6 years, 1913 to 1918.
Golden Rain	493	126.2	98.8	153.5	111.0	110.6	90.6	120.0	115.1
Early Mountain	754	103.8	120.3	158.5	111.0	111.8	83.7	121.0	114.8
Silvermine	720	102.2	113.6	163.6	106.2	109.3	80.6	119.0	112.5
Kherson	723	88.7	110.0	160.2	119.2	116.2	70.6	118.9	110.8
Rustless selection	724	103.8	120.3	158.5	68.7	120.6	75.9	114.4	107.9
Swedish Select	134	104.2	97.1	163.6	93.7	102.5	75.6	112.2	106.0
Sixty-Day	165	103.0	101.4	161.9	98.5	90.6	.....	111.1	.....
Lincoln	756	73.1	115.6	163.6	96.2	98.1	.....	109.2	.....

[1] Cereal Investigations number.

Figure 11 shows the average acre yields, in bushels, of the six leading varieties of oats grown on irrigated land at the Aberdeen substation in the 6-year period from 1913 to 1918, inclusive.

The Swedish Select oat is the most prominent variety now grown in southern Idaho. It has a large, plump, white grain and a high bushel weight. It is of very good quality and the market takes it readily. The Swedish Select, however, has not yielded as well as several other varieties. The Golden Rain has averaged 9 bushels per acre more than the Swedish Select each year in the 6-year period. The Early Mountain has outyielded the Swedish Select by 8.7 bushels

per acre. The Silvermine has outyielded it by 6.4 bushels per acre, and the Kherson has outyielded it by 4.7 bushels per acre in the 6-year period. The Kherson and Sixty-Day varieties have done very well. The Albion and Richland, white and yellow selections, respectively, from the Kherson, were substituted in 1918 for the Sixty-Day and Kherson varieties. The Kherson type of early oat seems well adapted to southern Idaho conditions and can well be used where desired as a nurse crop and at the high altitudes where the mid-season varieties do not mature in time to avoid frost.

Oats are not particularly recommended as a nurse crop because of the dense shade produced. When it is necessary to use them for that purpose in order to obtain horse feed, the Kherson type of early oat is recommended. The rate of seeding should be reduced to not more

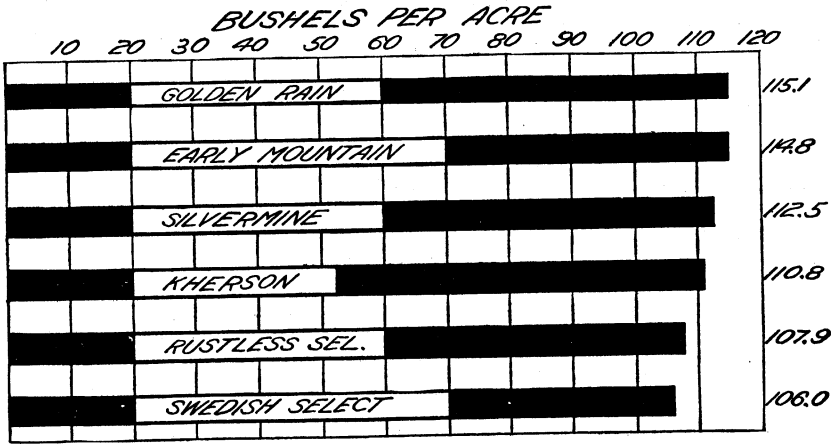

FIG. 11.—Diagram showing the average yields, in bushels per acre, of the six leading varieties of oats grown on irrigated land at the Aberdeen substation during the six years from 1913 to 1918, inclusive.

than 5 pecks per acre of the Kherson variety, as the kernels ar small and feed faster in the drill than the larger seeded varieties.

The best-yielding varieties of oats are all open panicled. The side oats, or so-called horse-mane oats, have never yielded as well as the open-panicled varieties. The grain from the side-oat varieties, while large, does not weigh as much per bushel as the grain of the open-panicled varieties, and the percentage of kernel to hull is not as high as it is in the open-panicled oat. The side oat has a very stiff straw which stands up well under irrigation, and seldom, if ever, grows as tall as that of the open-panicled oats. The great size and excellent appearance of the grain of the side oat have misled many people into sowing what really is an inferior variety for southern Idaho.

BARLEY.

The experiments with barley in the field plats under irrigation at the Aberdeen substation during the past six years have included 36 varieties. The yields of the seven leading varieties are given in Table III. These yields are shown graphically in figure 12.

Practically all varieties of barley do well in southern Idaho, as the yields clearly show. The Trebi is the most uniformly good variety for the irrigated lands of this section. It is a bearded 6-rowed barley which matures several days earlier than the Coast (California

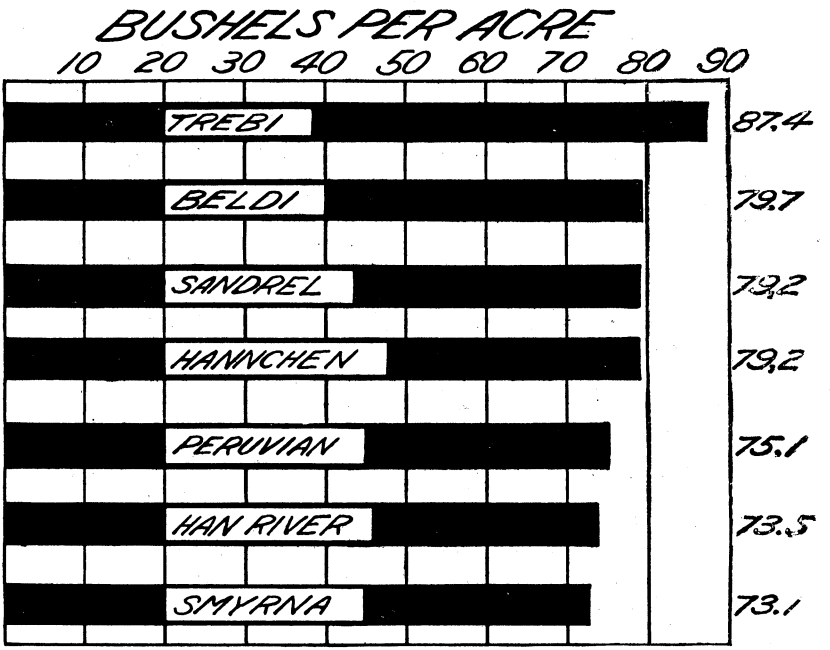

FIG. 12.—Diagram showing the average yields, in bushels per acre, of the leading barley varieties grown under irrigation at the Aberdeen substation during the six years from 1913 to 1918, inclusive.

Feed), a variety now grown quite widely in southern Idaho. The head of the Trebi is longer and broader than that of the Coast variety, and the kernels are broader and not quite so long. The Trebi thrashes cleaner than the Coast, is lighter in color, and weighs more per bushel. The Trebi, in the five years it has been grown at Aberdeen, has exceeded all other varieties in average yield by 7.7 bushels an acre. The wonderful performance record of this splendid variety warrants its general use on the irrigated lands of southern Idaho. In most irrigated sections of the State, Trebi barley should be grown rather than other varieties. A field of this variety which averaged 97 bushels to the acre is shown in figure 13.

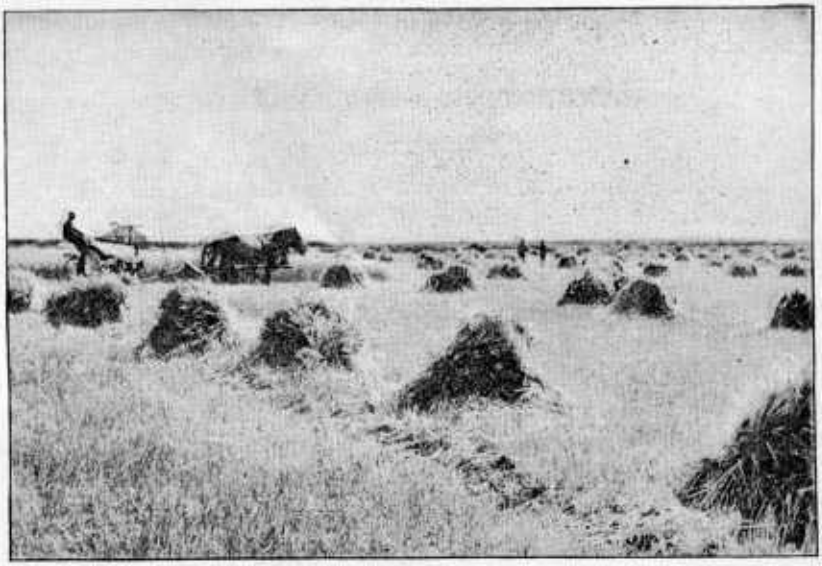

FIG. 13.—A field of Trebi barley on irrigated land which averaged 97 bushels to the acre.

TABLE III.—*Yields of seven leading varieties of barley grown on irrigated land at the Aberdeen substation during the 6-year period from 1913 to 1918, inclusive.*

[The yields of all varieties, including those of the hull-less type, are figured on the basis of 48 pounds per bushel.]

Variety.	C. I. No.[1]	Yield per acre (bushels).							
		1913	1914	1915	1916	1917	1918	Average.	
								5 years, 1914 to 1918.	6 years, 1913 to 1918.
Trebi	936	.....	85.9	84.0	69.6	105.0	92.8	87.4	.....
Hannchen	531	61.6	73.2	80.6	69.5	84.1	68.7	79.2	76.2
Beldi	190	56.0	88.2	80.6	62.4	96.6	70.7	79.7	75.7
Sandrel	937	.....	84.7	80.5	67.4	98.7	64.9	79.2	.....
Peruvian	935	.....	74.4	84.0	74.9	87.9	54.5	75.1	.....
Han River	206	78.3	68.7	81.7	67.4	92.9	57.0	73.5	74.3
Smyrna	910	69.5	70.4	63.8	90.4	87.5	53.7	73.1	72.5

[1] Cereal Investigations number.

At the Aberdeen substation the hull-less and hooded (bald) barleys have not approached the yield per acre, pound for pound, obtained from the hulled bearded barleys. A considerable acreage of hull-less bald (Nepal) barley is grown in the upper Snake River basin, probably showing that these barleys are adapted to this section of the State. The 2-rowed barleys do well in southern Idaho, but have not yielded as well as the Trebi. The Hannchen stands second in the list in yield per acre and the Smyrna stands seventh. The

Smyrna is an early dwarf variety with large, plump grains, but it is not able to yield in comparison with the other varieties.

HARVESTING AND THRASHING.

CUTTING.

The small grains should be cut before the grain is fully ripe. Wheat, oats, and barley shatter if not cut until fully ripe. When the grain has passed the hard-dough stage and is plump and glazed, it is ready to cut. If the crops are cut too early, shrinking of the kernel takes place, the kernel will not be plump and, as a rule, the weight per bushel will be lighter. In southern Idaho the warm, dry climate during midsummer hastens maturity. Where large areas must be cut with limited harvesting facilities, it often becomes necessary to cut part of the grain when somewhat green rather than lose some of the crop by shattering. Heavy windstorms often cause considerable loss from shattering in ripe grainfields.

CUTTING MACHINERY.

Binders, headers, and small combined harvesters, or combines, are used to cut the grain crops on irrigated lands in southern Idaho. The binder is used very extensively. The grain must be thoroughly ripe before the header or combine can be successfully used. On irrigated land where the grain is very thick and heavy it is hazardous to trust a well-matured grain crop to the weather, waiting two weeks for the grain to get ripe enough to harvest with a header or combine, when it can be cut with the binder and this great risk eliminated.

SHOCKING.

If the grain is cut somewhat green, only enough bundles should be put in one shock to make it firm. As a rule, the shocking process in southern Idaho is merely an assembling of bundles to facilitate loading for thrashing in the field or for stacking. Rain seldom falls during the harvesting period, and the care exercised in shocking grain in the humid areas is not required in southern Idaho. About 10 bundles make a good-sized shock. It is not necessary to cap shocks in this dry climate, and capping is often the source of considerable shattering, as the wind in the fall is occasionally strong enough to blow the cap bundles to the ground.

STACKING.

Thrashing from the field is an excellent way of saving time and a little labor. However, thrashing machines and crews must be plentiful to insure the work being done quickly and efficiently.

As a rule, stacking is far more satisfactory. When the grain is safely stacked the grower may exercise more care in the selection of his thrashing outfit. Grain always goes through a sweat, and it is

better to have it go through the sweat in the stack than in the bin. If the weather should happen to be damp, grain thrashed from the field and binned at once is very likely to heat and mold.

The following excellent directions for stacking are given in Farmers' Bulletin 892, entitled "Spring Oat Production:"

Stacking should be begun as soon as the grain is well cured in the shock, in about 10 days to two weeks after cutting. Round stacks are usually about 10 feet in diameter at the base. The usual plan is to build four stacks in a setting, in pairs 6 feet apart.

First build a large round shock about 8 feet in diameter. Then place two layers of bundles, one directly on top of the other, with the heads resting against the shock and the butts forming the 10-foot base of the stack. Make the next row with the butts just covering the bands of the outer row. In the same manner lay rows of bundles, like shingles, until the center is reached, overlapping the rows a little more toward the center of the stack. When the first layer is completed, begin again at the outside and build toward the center.

Shocked bundles have slanting butts, because they are set in the shock with a slight slant instead of exactly upright. In building the outside rows around the stack lay the long edge of the butt on top and projecting beyond the lower bundle. In this way the diameter of the stack is gradually increased, forming the bulge. After a height of 7 or 8 feet is reached, lay the outer bundles with the long edge of the butt beneath and just covering the inner edge of the layer just completed. In this way the diameter is gradually decreased and the stack is tapered slowly to a point.

Always keep the middle of the stack high and firmly tramped down. Do not tramp the outer layer at all. Keeping the middle high gives all the bundles a slant toward the outside and helps to shed rain. At the peak, where the bundles overlap, fasten a capsheaf securely by setting it on a sharpened stake driven into the top of the stack. A well-built stack 10 feet in diameter should be 20 to 25 feet high.

THRASHING.

A great deal of careless thrashing is done in southern Idaho. The quantity of work done per day is the usual gauge of a job, rather than the quality of work done. Very little effort, if any, is made to clean out the separator before moves are made from farm to farm. Mixtures of all varieties grown are rapidly being made as a result of this practice. Much grain is wasted because canvases are not used under the machine. Far too much grain is being cracked, owing to the improper adjustment of the cylinder and concaves. The high speed of the cylinder usually will crack wheat, as will also side play of the cylinder. To thrash Dicklow wheat which is in a normal dry condition a speed of 900 revolutions per minute is ample. Good work can be done with as low as 750 if two bars of concaves are used. Trebi barley requires about the same speed of cylinder, while oats as a rule need a little more speed. If the grain is damp more speed is required to do a similar grade of work.

It is important that all cylinder teeth center between the concave teeth. If the cylinder teeth are to one side or the other, cracked

grain is bound to result. Loose cylinder or concave teeth also will crack grain. The cylinder should be centered and all side play taken up before the boxings are permanently bolted.

Cracked grain will not grow, and it involves a useless waste which can easily be avoided. Thrashermen who do not know how to operate their outfits, so as to thrash and clean grain properly, should not be employed by the farmer. Dry grain thrashes cleaner and better than grain that is damp. Grain is often blown into the straw because the speed of the separator is too great. The farmer as a rule, however, gives more attention to the blow-over than he does to the cleaning of the grain or to the quantity of grain that is cracked or hulled. More care on the part of the farmer in connection with thrashing will result in greater profit and less trouble.

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